

***Carex juboanensis* (Cyperaceae), a New Species from Japan**

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Carex (sect. *Rhomboidales*) *juboanensis* J. Oda & A. Tanaka is described as a new species from the western and central Honshu, Japan. This new species is characterized and clearly distinguished from its allies in the sect. *Rhomboidales* by the actively stoloniferous habit and the emarginate scales of both staminate and pistillate flowers. The micromorphology of achene surface is also different from that of its allies.

Key words: achene, *Carex juboanensis*, *Carex* sect. *Rhomboidales*, Cyperaceae

The genus *Carex* L. is one of the largest genera comprising about 2000 species in the world, and of which more than 200 species are distributed in Japan (Mabberly 1997).

Carex sect. *Rhomboidales* Kük. is characterized by the bract long sheathed with short blades; staminate spike long peduncled; pistillate spikes remote, erect, oblong to cylindrical; perigynia rather large with a bidentate long beak, and stigmas 3, rare 2 (Ohwi 1936). Ohwi (1936) recognized 14 taxa from Japan and adjacent regions in the sect. *Rhomboidales*. *Carex juboanensis*, a new species to be described here, shares all of these characters. Although the infrageneric system of the genus *Carex* is not well established (e.g. Ohwi 1936, Akiyama 1955, Egorova 1999, Liang *et al.* 2000), we place the new species in the sect. *Rhomboidales* following Ohwi's (1936) treatment in this paper.

Carex juboanensis was found by Tanaka in 1983 at Mt. Jubo-zan, Tottori Pref. and by Oda in 2000 at the Tsuruga Peninsula, Fukui Pref., independently. Its actively stoloniferous habit, which is

not common in the section, attracted their attention, but taxonomic position of these plants have been left unstudied. Here we describe a new species, *Carex juboanensis*, on the basis of the comparative study in the section.

Materials and Methods

For comparative studies of gross morphology, the herbarium specimens of *Carex* sect. *Rhomboidales* deposited in HYO, KANA and KYO were examined. Some living materials of *Carex juboanensis*, which were transplanted to the private garden of Yao-shi, Osaka Pref., from Mt. Jubo-zan, Mt. Nariai-san, and the Tsuruga Peninsula, were also used for our studies.

For micromorphology of achenes, achenes were taken out of the dissected perigynia and soaked for 18-24 hr in the acetolysis solution (concentrated sulfuric acid : acetic anhydride 1 : 9 v/v), then rinsed in acetic acid for 10 min, and placed in a bath-type ultrasonic cleaner for 30 min with 70 % ethanol to

remove the cuticle and outer periclinal wall of epidermis. After air-dried for one day, achenes were sputter-coated with gold using JEOL JFC 1200 sputter coater, and examined using JEOL JSM-5800LV scanning electron microscope at 10 kV. The materials used for the microstructure of achene surface were listed in Appendix.

Result and Discussion

Carex (sect. *Rhomboidales*) **jubozanensis** J. Oda & A. Tanaka, **sp. nov.** –Figs. 1, 2, 3A, 3F & 4.

Species nova affinis *Carex xiphio* Komar. et *C. longerostratae* var. *pallidae* (Kitag.) Ohwi, sed a priore rhizomatibus impigre stoloniferis et squamis masculis femineisque emarginatis, a posteriore vaginis basalibus in fibras non dissolutis et foliis latoribus differt. – *Type*: JAPAN: Mt. Jubo-zan, Shikano-cho, Ketaka-gun, Tottori Pref., alt. 500 m, 16 July 2000, *A. Tanaka* 37517 (holo- KYO; iso- OSA, TNS, TI, TUS).

Perennial herbs, actively stoloniferous. *Culms* lateral, trigonous, 20–40 cm high; sterile culms often observed. *Basal sheaths* light brown, not dissolved to fiber. *Leaves* light green, plane linear, about as tall as culms, 4–8 mm wide, two lateral-ribbed; bulliform cells arranged in a single layer. *Spikes* 2–3; terminal spike staminate, light brown, clavate to narrowly clavate, 2–3 cm long, long-peduncled; lateral spikes pistillate, 1–2, few flowered, remote, 1.5–2 cm long. *Bracts* 2–4 cm long, sheathed, with a short blade not overtopping the spike. *Staminate scales* narrowly obovate, light rusted brown except for the green center and pale green margin, 3-nerved, emarginate and shortly aristate at apex, the arista ciliate. *Stamens* 3; anthers 5 mm long. *Pistillate scales* ovate, pale green to light brown with a green center, 3 nerved, 6–7 mm long, emarginate and shortly aristate at apex, the arista ciliate. *Perigynia* ovate, glabrous, with a rather long beak

(3–3.5 mm long), trigonous, 5.5–8 mm long, often scabrous at sides of beak, rather deeply bidentate; veins many but inconspicuous. *Achenes* obovoid, trigonous not excavated at the middle of 3 ridges, supported by a short and curved stipe, often strongly curved at apex connecting the style. *Stigmas* 3.

Japanese name: San'in-hiesuge (nov.)

Distribution: Japan, endemic. Japan Sea side of the western and central Honshu: Fukui, Kyoto, Hyogo and Tottori Prefs. (Fig.4).

Habitat: Hill forest dominated by *Pinus densiflora* Siebold & Zucc. on rather poor soils.

Other specimens examined: **Fukui Pref.**: Mt. Oniga-take, Takefu-shi, 11 May 1960, *S. Watanabe* s.n. (KANA); Mt. Nosaka-dake, Tsuruga-shi, alt. 250m, 13 Jun. 2001, *T. Wakasugi* 0106131 (KYO); Takenami, Mihama-cho, Mikata-gun, alt. 20m, 24 Jun. 2000, *J. Oda* 933 (KYO); Tateishi, Tsuruga-shi, 21 May 2002, *A. Tominaga* s.n. (KYO); Tsunemiya, Tsuruga-peninsula, Reinan, 20 Apr. 1969, *S. Watanabe* s.n. (KANA, KYO). – **Kyoto Pref.**: Mt. Nariai-san, Nariai-ji, Miyazu-shi, alt. 330m, 11 May 2003, *J. Oda* 1287 (KYO). – **Hyogo Pref.**: Mt. Kuruhi-dake, Kinokuni-cho, Kinokuni-gun, 11 Aug. 1974, *S. Hosomi* 14249 (HYO). – **Tottori Pref.**: Mt. Jubo-zan, Shikano-cho, Ketaka-gun, alt. 500m, 29 Apr. 1983, *A. Tanaka* 30447 (KYO); Shichi-yama, Iwami-cho, Iwami-gun, alt. 280m, 10 Jun. 2003, *A. Tanaka* 37620 (KYO).

Morphological characters

Table 1 shows the morphological comparisons between *Carex jubozanensis* and its allies in the sect. *Rhomboidales*. The unique character of *C. jubozanensis* is the actively stoloniferous habit (Fig. 2). The stoloniferous habit is found only in *C. longerostrata* C. A. Meyer var. *pallida* (Kitag.) Ohwi in other members of the sect. *Rhomboidales*, although it is not so active as in *C. jubozanensis*. The type variety, var. *longerostrata* is different from the var. *pallida* only in lacking stolons. *Carex longerostrata* including both varieties is similar to *C. jubozanensis* also in having staminate scales emarginate-obtuse, achenes not excavated at the middle of 3 ridges, and a style curved at base, but it is

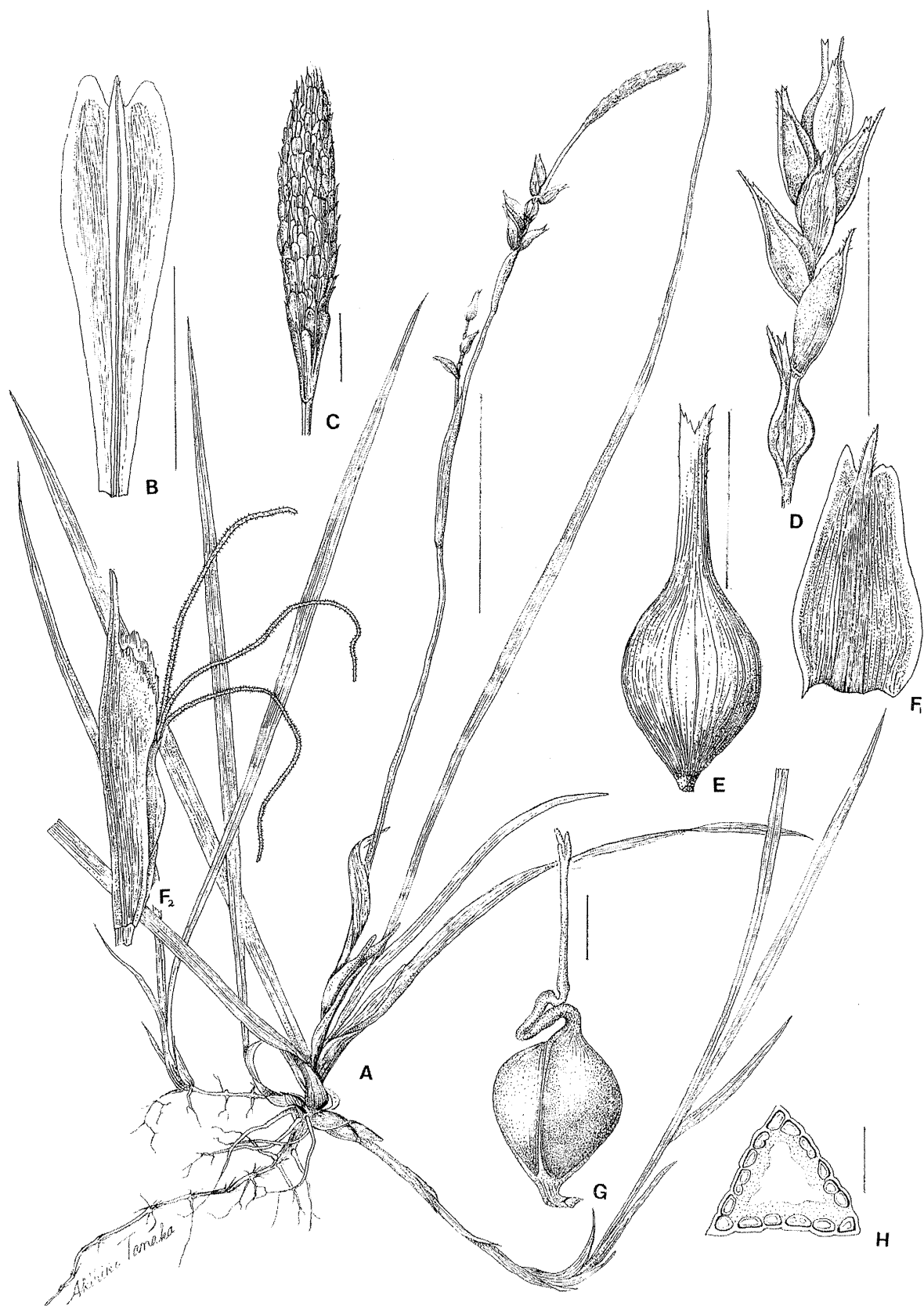


FIG. 1. *Carex jubozanensis* J.Oda & A.Tanaka. A: habit; B: staminate scale; C: staminate spike; D: pistillate spike; E: perigynium; F₁: pistillate scale; F₂: pistillate flower; G: achene; H: cross section of culm. Bar = 5 cm for A; 1 cm for D; 5 mm for B, C; 4 mm for E, F₁; 2 mm for H; 1 mm for G.



FIG. 2. *Carex jubozanensis* with a stolon creeping up on a bole of a *Pinus densiflora*. Mt. Jubozan, 20 Apr. 1997.
Photographed by A. Tanaka.

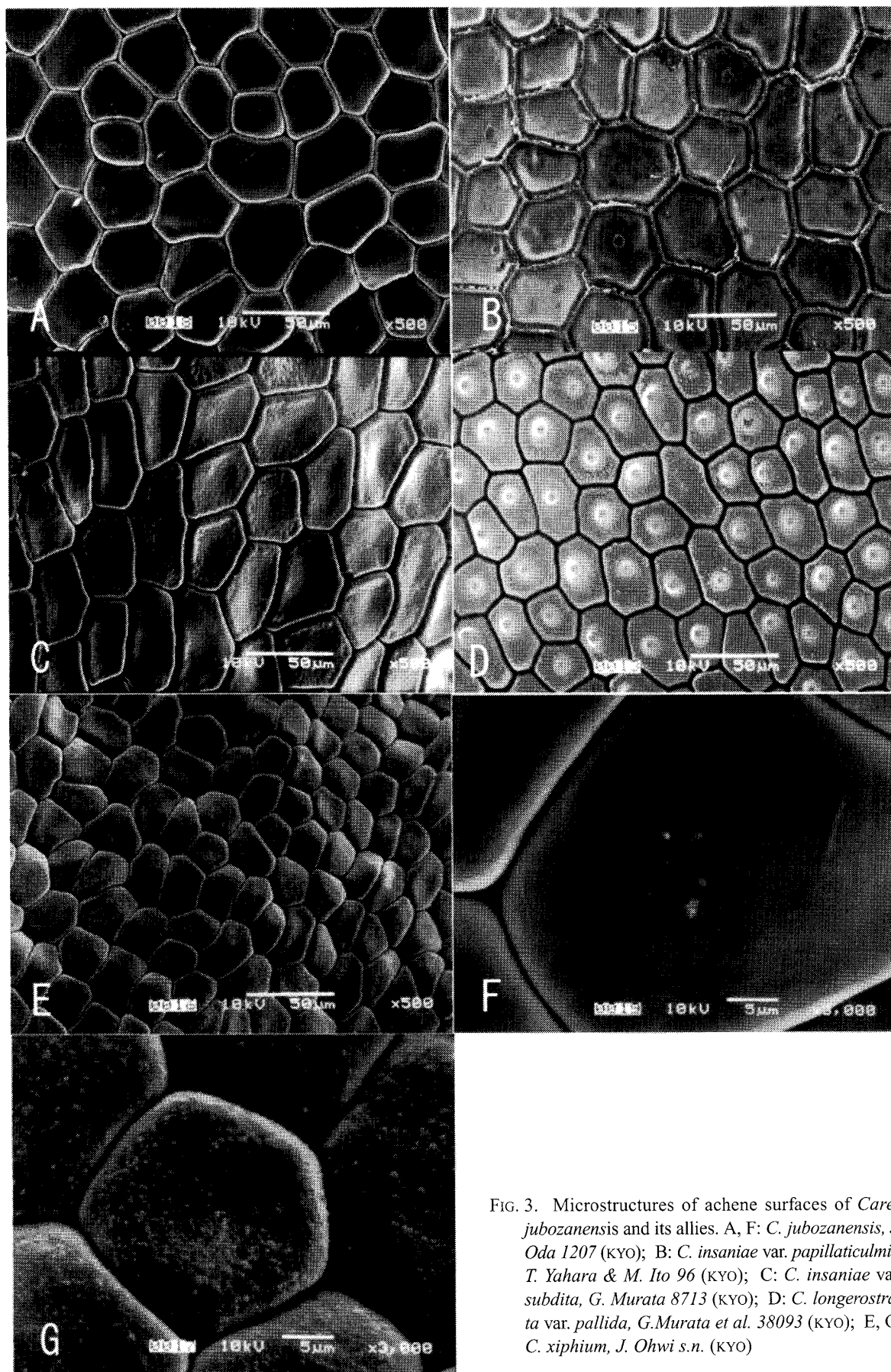


FIG. 3. Microstructures of achene surfaces of *Carex juboanensis* and its allies. A, F: *C. juboanensis*, J. Oda 1207 (KYO); B: *C. insanae* var. *papillaticulmis*, T. Yahara & M. Ito 96 (KYO); C: *C. insanae* var. *subdita*, G. Murata 8713 (KYO); D: *C. longirostrata* var. *pallida*, G. Murata *et al.* 38093 (KYO); E, G: *C. xiphium*, J. Ohwi s.n. (KYO)

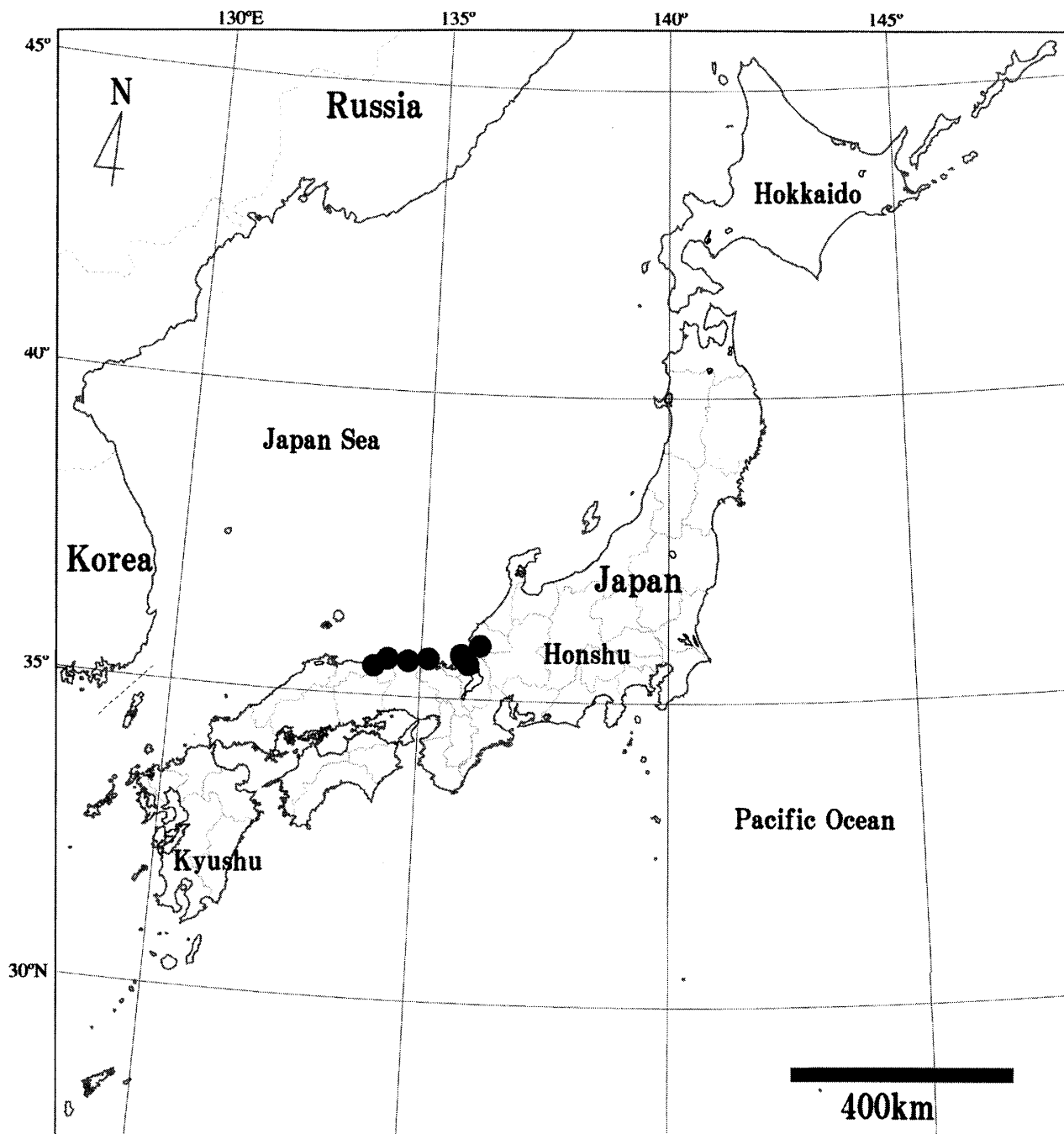


FIG. 4. Distribution of *Carex juboanensis*

clearly distinguished from the latter by the basal leaf sheaths dissolved to fiber and by narrower leaf blade. The long ascending rhizomes of *C. xiphium* are sometimes confused with creeping stolons. This plant also has achenes not excavated as well as *C. juboanensis*, but the scales of spike are never emarginate but acute or shortly truncate, and the basal leaf sheaths are dissolved to fiber as in *C. longeros-*

trata. *Carex xiphium* is different from *C. juboanensis* in having a style straight at base, too.

In the distribution area of *Carex juboanensis*, the closely related and confusable sedge is *C. insanae* Koidz. var. *papillaticulmis* (Ohwi) Ohwi. The basal leaf sheaths are not dissolved to fiber and the leaves are (4-)5-8 mm wide as in *C. juboanensis*. This plant is, however, never bearing stolons but

TABLE 1. Comparison of morphological characters between *Carex juboanensis* and its allies.

	<i>C. juboanensis</i>	<i>C. insanae</i> var. <i>papillaticulmis</i>	<i>C. insanae</i> var. <i>subdita</i>	<i>C. longerostrata</i> var. <i>pallida</i>	<i>C. xiphium</i>
Growth habit	actively stoloniferous rhizomes	cespitose rhizomes	cespitose rhizomes	stoloniferous rhizomes	with lignified and ascending rhizomes
Basal sheath	not dissolved to fibers	not dissolved to fibers	not dissolved to fibers	dissolved to fibers	dissolved to fibers
Leaf width (mm)	(4)-5-8	(4)-5-8	3-5	3-4	6-8
Number of pistillate spike	1-2	2-3-(4)	2-3	1-(2)	2-(3)
Shape of Staminate scale	emarginate	acute-obtuse	acute-obtuse	emarginate-obtuse	obtuse-truncate
Hairiness of perigynium	glabrous	pubescent	pubescent	glabrous or pubescent	glabrous
Length of perigynium (mm)	5.5-8	6-8	5-7	6-8	5-7
Apex of beak on perigynium	deeply bidentate	bidentate	bidentate	bifid	deeply bidentate
Middle of achene	not excavated	slightly excavated	slightly excavated	not excavated	not excavated
Apex of achene	not swollen	swollen	not swollen	not swollen	not swollen
Basal part of style	curved	straight	curved	curved	straight

growing in a dense tuft, and different from *C. juboanensis* in the pubescent perigynia, the slightly excavated achenes at the middle of 3 ridges, and the straight style at base. *Carex insanae* var. *subdita* (Ohwi) Ohwi distributed in the Pacific Ocean side of Japan has a style curved at base and achenes not swollen at apex as *C. juboanensis*, but the leaves are narrower (3-5 mm wide) and in other characters it is as same as var. *papillaticulmis*.

Achene micromorphology

Micromorphology of achene surface of Cyperaceae is very variable and has been regarded as a taxonomically useful character. The shape and surface sculpture of silica bodies deposited on the inner periclinal wall of epidermis often have taxonomic values in recognizing taxa (Toivonen & Timonen 1976, Hoshino 1984, Wujek & Menapace 1988, Rettig 1990, Dan & Hoshino 1994, Oligun & Beyazoglu 1997, Liu & Lin 1999). In the present

study, the achene micromorphology were examined of *Carex juboanensis* and its allies discussed above. Fig. 3 shows the scanning electron micrographs of their achene surfaces after removing the cuticle and outer periclinal cell wall by acetolysis. In all species studied here, the cells were irregularly 4-7-gonal, 20-50 μm in diameter, and periclinal wall was straight or curved. The deposited silica body fully filled the lumen forming a platform. In *C. juboanensis*, the platform of silica body was more or less flat and smooth (Fig. 3A, 3F), and different from that of any allied species. In *C. insanae*, the platform is slightly concave and the remnant of the anticlinal walls was often observed between silica bodies (Fig. 3B, 3C). *C. longerostrata* var. *pallida* (Fig. 3D) has a distinct silica body; the platform was convex and with a tuberculate protrusion in the center. This taxon shares the stoloniferous habit with *C. juboanensis*, but the micromorphology of achenes was clearly different

between these two species. In *C. xiphium* (Fig. 3E, 3G), the cells were smaller (20-30µm), and the platform was more or less flat but scabrate with granules.

Reproductive biology

The new species, *Carex jubozanensis*, is restricted to the Japan Sea side of the western and central Honshu, growing in rather dry hill forests dominated by pine trees (*Pinus densiflora*) on poor soils. It is rather a rare species distributed in disjunct small populations. In the field observation, mature achenes were rarely found. It seems that this plant mainly depends on vegetative reproduction by actively producing long stolons. However, in cultivated condition, some individuals set many mature achenes. These plants were collected from several localities such as Mt. Jubo-zan, Mt. Nariai-san, and the Tsuruga Peninsula, and cultivated together at the private garden at Yao-shi, Osaka Prefecture. It is uncertain whether the increase of fruit-set is due to the promotion of outcrossing, or due to the improvement in nutrient or light conditions.

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Appendix

Collection data for *Carex* species used for SEM observation

Carex jubozanensis J. Oda & A. Tanaka

Mt. Jyubozan, Tottori pref., *A. Tanaka* 37515 (KYO);
Mt. Jubozan, Tottori pref., *J. Oda* 946 (KYO);
Tsuruga peninsula, Fukui pref.(cult.), *J. Oda* 1208 (KYO);
Tsuruga peninsula, Fukui pref., *J. Oda* 932 (KYO)

Carex insanae Koidz. var. *papillaticulmis* (Ohwi) Ohwi
Yokote-shi, Akita Pref., *Y. Horii s.n.* (KYO); Mt.
Hira-san, Shiga Pref., *T. Yahara & M. Ito* 96 (KYO);
Mt. Ishizuchi-san, Ehime Pref., *Tak. Shimizu* 80157 (KYO).

Carex insanae Koidz. var. *subdita* (Ohwi) Ohwi
Mt. Asama-yama, Mie Pref., *G. Murata* 8713 (KYO);
Okinoshima Isl. Sukumo-shi, Kochi Pref., *Tak. Shimizu* 8347 (KYO).

Carex longerostrata C. A. Meyer var. *pallida* (Kitag.)
Ohwi

Sachalin: Sakaehama, *S. Otagiri* & *J. Ohwi s.n.*
(KYO); Sohya, Hokkaido Pref., *G. Murata* & *H.*
Koyama 38115 (KYO); Mt. Apoi-dake, Hokkaido
Pref., *K. Deguchi* & *T. Takahashi 7096* (KYO);

Tateshina, Nagano Pref., *T. Ohmura 18398* (KYO);
Mt. Kuju-zan, *J. Ohwi s.n.* (KYO).

Carex xiphium Komar.

North Korea: Chan-pensyon in Musang, *J. Ohwi*
s.n. (KYO); North Korea: Genpori, Kankyo-nando, *J.*
Ohwi s.n. (KYO)

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